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of the Times will be discovered, which will serve for ever afterwards as a Rule to adjust the Observations.

The only View that I have in communicating this Paper, and in computing the Eclipses for Time to come, is to encourage those Persons, who will find their Advantage in it, to make Use of this Help for obtaining the Longitude at Sea, till better Methods are offered.

V Experiments and Observations upon the Light that is produced by communicating Electrical Attraction to animal or inanimate Bodies, together with some of its most surprising Effects; communicated in a Letter from Mr. Stephen Gray, F. R. S. to Cromwell Mortimer, M. D. R. S. Secr.

S I R,

Charter-House, Jan. 28th, 1734-5.

IT is now some Months ago that I promised to give the Society an Account of what Experiments I had then made; but soon after there occurr'd to my Thoughts several others, which I was willing to try the Success of; which Experiments requiring an Addition to the Apparatus, that I might make them more compleat, I hope will be a sufficient Apology for this Delay.

I see you have published Mr. Dufay's Letter to the Duke of Richmond, in the *Philosophical Transactions*,

actions, № 431. 'tis no small Satisfaction to me, that my Electrical Discoveries have not only been confirmed by so judicious a Philosopher as Mr. *Dufay*; but that he has made several new ones of his own, more especially that important luciferous one, which put me upon making the Experiments I am now going to relate.

I shall first give some Account of the Experiments made the last *Spring*, soon after I received the Translation of Mr. *Dufay's Letter*; then of those we made at my honoured Friend's, *Granville Wheeler, Esq; F.R.S.* in the Months of *July* and *August*; and lastly proceed to those I have made since my Return to *London*, which was in *September* last.

As I had not any silk Lines by me strong enough to bear the Boy, I caused him to stand on some of the Electric Bodies; and, as I concluded, found the Effect the same as mentioned by Mr. *Dufay*. I shall not need to mention the Particulars of the Experiment, but proceed to those that were suggested to me upon Mr. *Dufay's saying*, that these Snappings or Sparks are not excited, if a Piece of Wood, or any other Substance than a living Body, be passed over the Person suspended on the Lines, unless it be a Piece of Metal: From thence I concluded, that if I suspended the Metal upon silk Lines, or laid it upon any of the Electric Bodies, the Effect must be the same, when the Metal had been made Electrical by the Tube, and the Hand of any one was held near it, and found it succeeded accordingly. I began first with some common Utensils that were at Hand, such as the Iron Poker, Tongs, and Fire Shovel; any of these being suspended upon Lines of the largest sewing Silk then

the excited Tube, being applied first to the Knob of the Poker, and after it the Hand, there was the Snap and Pricking felt, as I expected ; and the Effect was the same, when the Tube was first applied to the other End of the Poker. I had by me a three pronged Iron Instrument, which was made many Years ago ; its Use was designed for propping up the Observatory Table, when I observed the Spots in the Sun ; the Prongs were about half an Inch Diameter, two of them about 22 Inches, and the third about 8 Inches long ; they were tapering towards the Ends, and pointed : this being laid either upon Cylinders of Glass, Cakes of Rosin and Bees Wax, or on a Cake of Sulphur, the Tube being applied to the End of any of the Legs, the Hand or Cheek being applied near the other, both the other Legs had the same Effect as that to which the Tube had been applied ; but by holding my Cheek near any of the Points of the Legs, the pricking or burning Pain was much more sensibly felt, and was sometimes felt for several Minutes after. I was not so inquisitive at that Time about making the Experiment in the Dark, that I might see the Light proceeding from the Iron, not thinking the Electricity communicated to the Metals would have produced so surprising Phænomena, as by the following Account of the Experiments will be described.

I come now to give some Account of the Experiments we made at Mr. *Wheeler's*, beginning first with the Success we had in repeating Mr. *Dufay's* Experiment. Mr. *Wheeler*, soon after my coming to him, procured silk Lines strong enough to bear the Weight of his Footboy, a good stout Lad ; then having suspended him upon the Lines, the Tube being applied

applied to his Feet or Hands, and the Finger of any one that stood by held near his Hands or Face, he found himself pricked or burnt, as it were by a Spark of Fire, as Mr. *Dufay* had related, and the snapping Noise was heard at the same Time; but it did not succeed with us, when we applied our Hands to any part of his Body through his Cloaths, except upon his Legs, upon which he felt the Pain through his Stockings, although they were very thick ones.

2. Being desirous to make the Experiment upon another Species of Animals, we took a large white Cock, and suspended him upon the Lines first alive, and the Effect was the same as on the Boy, whether we applied our Fingers to any Part of his Body, or our Cheek to his Beak, Comb or Claws; then the Cock was killed, and put on the Lines again, and we found very little, if any, Difference, from the Effect it had on us when the Cock was living: We then caused the Cock to be stripped of his Feathers, and the Difference from what has been said before was not very great.

3. We took a large Sirloin of Beef, that came from an Ox that had been killed two Days before, and suspended it on the silk Lines; then the Fingers held near any Part of it, there was a Snapping, and the Fingers were pushed or pricked; but the Snapping was thought not to be quite so loud as when the Experiment was made on the Cock.

4. We caused to be made an Iron Rod, 4 Foot long, and about half an Inch Diameter, pointed at each End, but not sharp, being left about the Bigness of a Pin's Head, this being suspended on the Lines; then the Tube being rubb'd, and held near one End of the

Rod, and then the Finger or Cheek being put near either End of the Rod, the Effect was the same as when an Animal had been suspended on the Lines, with respect to the pricking Pain we felt.

5. At Night we made the luminous Part of the Experiment, suspending the Iron Rod on the silk Lines; then applying one End of the Tube to one End of the Rod, not only that End had a Light upon it, but there proceeded a Light at the same Time from the other, extending in Form of a Cone, whose Vertex was at the End of the Rod, and we could plainly see that it consisted of Threads, or Rays of Light, diverging from the Point of the Rod, and the exterior Rays being incurvated. This Light is attended with a small hissing Noise; every Stroke we give the Tube, causes the Light to appear: the Hissing seems to begin at that End of the Rod next the Tube, and as it comes, increases in its Loudness, but it is so small as not to be heard without good Attention, and by those only that stand at that End of the Rod from whence the said Light proceeds.

Mr. Godfrey being desirous to see these Experiments, I repeated them, by laying a Rod of Iron upon a Cake of Shell-Lake, which was laid upon a Glass Vessel; but the Effects being much the same with what has been above-mentioned, I shall not need to mention any other Particulars.

1. I shall now proceed to give some Account of the Experiments I have made since my Return to *London*, which was in *September* last. I caused three Iron Rods to be made, one of four Feet long, two, each three Feet in Length; one of these was made tapering toward the Ends, and pointed as that of four Feet
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was ; the other pointed at one End, and the other End not pointed, the Diameter of the Rods about half an Inch ; they were first forged, then filed and burnished. With these I made the following Experiments : When any of them were laid either upon the Brims of hollow Cylinders of Glass well warmed, or upon Cakes of Rosin and Bees Wax, or upon those of Sulphur, the Phænomenon was the same as when they had been suspended on Silk Lines : But now I discover'd another very surprising one, viz. that after the Tube had been applied, and the Light seen at both Ends, upon my going to the other End of the Rod, when there was no Light to be seen, upon holding my Hand at some distance from it, then moving my Hand towards it with a pretty swift Motion, there issued from that Point of the Rod a Cone of Light, as when the Tube had been applied to the other End ; and upon repeating this Motion of my Hand, the same Phænomenon appear'd for five or six times successively, only the Rays were each time shorter than the other ; these Lights are also attended with a hissing Noise : That Light which appears upon that End next the Tube, when it is held obliquely to the Axis of the Rod, has its Rays tending towards it : All the Time I am rubbing the Tube, these Flashes of Light appear upon every Motion of my Hand up or down the Tube, but the largest Flashes are produced by the Motion of my Hand downwards.

2. When two or three Rods are laid either in a right Line, or making any Angle with each other, or either touch, or are at a small Distance from one another, the Tube being applied to one of their Ends, the furthest End of the further Rod; exhibits the same Phænomena as one single :

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3. An Experiment with the Rod that was pointed at but one of its Ends. When the Tube is applied to the other End of the Rod, the Point gives the same Appearance and alike Effect with the Rods, that are pointed at each End; but the great End of the Rod, when the Hand or Cheek is applied near it, gives but one single Snap; but this is much louder than the greatest of those from the Point of the Rod, and one feels a little more Pain by it.

4. I caused an Iron Ball to be forged, and then turned and burnished; 'twas two Inches Diameter, which being placed on a wooden Stand, that had a small Concave at the Top, in which the Ball was placed; the Stand being set upon a Cylindrick Glass, then the excited Tube being applied near the Ball, there proceeded a Stream of Light from it, with a small hissing Noise; then putting my Finger or Cheek near the Ball, there was no Snapping, nor any Pain felt, yet there appeared a very bright Light.

5. The Rod of four Feet long, being placed upon a Stand, that had a cross Arm with a Groove in it to receive the Rod; then the Stand being placed on the Glass Cylinder, they were set at such a Distance, as that one of the Points of the Rod might just touch the Ball over against its Centre; then going to the other End of the Rod with the prepared Tube, and applying it as usual, when I came to the Ball, the Hand or Cheek being near it, caused a loud Snap, compared to those made by the Points of the Rods, and the Pain of pricking or burning was more strongly felt, the Light also was brighter and more contracted: I then placed the Rod with its Point at an Inch

Inch distance from the Ball, and applying the Rod as before, I came to the Ball, and touching it with my Hand or Finger, there not only appeared a Light on the Ball, but there also proceeded a Brush of Light from the Point of the Rod after the same manner as when the Experiments had been made with the Rods only.

6. An Experiment made with the four Feet Rod, and a Brass Plate four Feet square. This was placed upon a Stand, so that the Plate stood perpendicular, the Stand being set on the Cylindrick Glass; then the Rod with its Stand and Glass was set so as that one Point of it was about an Inch from the Centre of the Plate; then the Tube being applied to the other End of the Rod, and after going to the Plate, on striking it gently with my Finger on the back Side, a Light appeared upon the Plate, and at the same time the Brush of Light caine out from the Point of the Rod; and when my Hand or Check was held near any of the Angles of the Plate, there was a Light came from thence with a small hissing Noise, and the Pricking was felt as when the Experiments were made with the pointed Rods.

7. A Pewter Plate being laid upon the Stand, which had been set upon a Glass Cylinder, the Tube first, and then the Finger applied, there appeared a Light upon the Plate, and the End of the Finger was pushed; and when the Check was held near the Edge of the Plate, there was a Snapping heard, but not so loud as when the Iron Rods were used. I then filled the Plate with Water, and applying the Tube and Finger as before, there was the same Light, pushing of the Finger, and Snapping, as when the Experiment was made with the empty Plate. When the Experiment is made with Water by Day-light, by applying
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the End of the Finger near the Surface of the Water, it appears to rise in a little Hill, and upon the snapping Noise falls down again, putting the Water into a waving Motion near the Place where the Water had risen.

8. I then took a wooden Dish, and placed it upon the Stand first empty; then applying the Tube, and the Finger held near the Dish, there appeared a Light, but no pushing of the Finger nor Snapping: I then filled the Dish with Water, and the Tube being held over the Surface of the Water, there appeared a greater Light than when the Finger had been applied to the empty Dish, but no Snapping, till by holding the Tube after it had been well rubbed, within two or three Inches of the Finger that was held near the Surface of the Water, and then the Finger was pushed, and a snapping Noise heard, as when the Experiment was made with the Pewter Plate.

By these Experiments we see, that an actual Flame of Fire, together with an Explosion, and an Ebullition of cold Water, may be produced by Communicative Electricity; and altho' these Effects are at present but in *minimis*, it is probable, in Time there may be found out a Way to collect a greater Quantity of it; and consequently to increase the Force of this Electrick Fire, which, by several of these Experiments (*Silicet magnis componere parvā*) seems to be of the same Nature with that of Thunder and Lightning.

S I R,

*Your's and the Society's Most Obedient
Humble Servant,*

STEPHEN GRAY.